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A Comparison of Stimulus-Stimulus Pairing, Standard Echoic Training, and Control Procedures on the Vocal Behavior of Children With Autism

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An alternating treatments design was employed to compare the effect of stimulus-stimulus pairing, standard echoic training, and a control condition on the vocal behavior of 3 preschoolers with autism. Data were recorded during pre- and postsession observations. During the stimulus-stimulus pairing condition, the experimenter's vocal model was paired with the delivery of a preferred item. During the standard echoic training condition, the experimenter presented a vocal model and delivered a preferred item contingent on an echoic response. During the control condition, the experimenter presented a vocal model and, after a 10-s delay, presented a preferred edible item. Results from the post-session observations during the stimulus-stimulus pairing condition showed an immediate but temporary increase in the target sound for 1 participant only. Implications and suggestions for future research are provided.
Key words: autism, automatic reinforcement, stimulus-stimulus pairing, echoic training, verbal behavior

Learning to speak and communicate vocally in one's native language is a complex process that involves many behavioral phenomena. Perhaps most apparent, from a behavior analytic perspective, are the roles of reinforcement and shaping. Infants often produce sounds that encounter conditioned reinforcers in the form of caregiver attention (praise, touch, etc.), and these sounds in turn are shaped toward more sophisticated vocal verbal behavior (words and sentences, etc.) that are reinforced directly. However, given that most children acquire language with relative ease and speed, direct reinforcement and shaping cannot account for the entirety of language development (Esch, Carr, & Michael, 2005).

The concept of automatic reinforcement (Skinner, 1957; Vaughn & Michael, 1982) has been offered as an explanation for the phenomenon of language acquisition in the absence of direct or mediated reinforcement. Automatic reinforcement as it relates to early language acquisition may occur through a process of pairing previously neutral stimuli (e.g., adult vocalizations) with conditioned or unconditioned reinforcers that are delivered during feeding, diaper changing, and other routines. As children produce sounds that resemble those produced by adults, these sounds may function as automatic reinforcement due to the pairing history. This process may account for the shaping of vocalizations that are similar to, and reinforced by, a child's own verbal community (Palmer, 1996).

Recent research has investigated the role of automatic reinforcement in early language acquisition and how a stimulus-stimulus pairing procedure may be used to facilitate the language development of typically developing children and children with developmental disabilities, including autism (Esch, et al., 2005; Miguel, Carr, & Michael, 2002; Normand & Knoll, 2006; Smith, Michael, & Sundberg, 1996; Sundberg, Michael, Partington, & Sundberg, 1996; Yoon & Bennett, 2000). For behavior analysts who endeavor to teach language skills to children with autism with deficient vocal verbal repertoires, the stimulus-stimulus pairing procedure holds theoretical promise as a means to increase spontaneous vocalizations and de-

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Table 1
Summary of Stimulus-Stimulus Pairing Research to Date

Author(s)	Pairing effect?	# of pairing trials per session	# of sounds per pairing trial	Age(s)	Diagnosis	Existing echoic skills (BLA[1])	Reinforcer
Sundberg et al., 1996	Yes	15 per min	1	4 yrs	MR[2]	5*	Social
	Yes	15 per min		4 yrs	Autism	4*	
	Yes	7.5 per min		2 yrs	DD[3]	1*	
	Yes	2.5 per min		3 yrs	Autism	2*	
	Yes	3.3 per min		2 yrs 6 mo	Typical[4]	Age appropriate	
Smith et al., 1996	Yes	7.6 per min	1	11 mo	Typical	Age appropriate	Social
	Yes	8.8 per min		1 yr 2 mo	Typical	Age appropriate	
Yoon & Bennett, 2000	Yes	12 per min	1	3 participants	Severe DD	1*	Social
	Yes	12 per min		ages 3-4 yrs		1*	
	Yes	12 per min				1*	
Miguel et al., 2002	Yes	≤4.0 per min	5	5 yrs	Autism	1*	Edibles
	No	≤4.0 per min		3 yrs	Autism	1*	
	Partial			5 yrs	Autism	3*	
Esch et al., 2005	No	≤7.5 per min*	3	6 yrs 10 mo	Autism	1	Edibles/ toys
	No	≤7.5 per min*		6 yrs 11 mo	Autism	1	
	No	≤7.5 per min*		8 yrs 2 mo	Autism	1	
Normand & Knoll, 2006	No	≤6.0 per mind*	7	3	Autism	3*	Toys/ edibles

[1]BLA = Behavioral Language Assessment: 1 = Cannot repeat any sounds or words; 2 = Will repeat a few specific sounds or words; 3 = Will repeat or closely approximate several sounds or words; 4 = will clearly repeat any word, or even simple phrases
[2]MR = mental retardation
[3]DD = developmental delay
[4]Typical = typically developing
*Estimated by first author from information provided in article

velop echoic responding. However, the results of research in this area have been inconsistent to date. In order to identify variables that may be related to this inconsistency, key elements of previous stimulus-stimulus pairing studies are summarized in Table 1.

Table 1 reveals a number of elements that appear to be related to research outcomes. They include: (1) the chronological age and diagnosis of the participants; (2) the preintervention vocal repertoires of children for whom stimulus-stimulus pairing has and has not produced an increase in postpairing production of target sounds; (3) the number of pairing trials presented, including the number of times the experimenter produced the sound during each trial and the timing of the pairing trials themselves; and (4) the nature of the second stimulus (i.e., the presumed conditioned reinforcer) as either edible/tangible or socially mediated. In general, pairing effects were more likely when the participants were younger (i.e., 2–4 year olds vs. 5–8 year olds), when the procedure involved more trials per minute and fewer presentations of the target sound per trial, and when the target sound was paired with socially mediated reinforcement (e.g., tickles, etc.) rather than edibles/toys. With regard to the latter, Table 1 shows clearly that the three earliest studies, which showed the greatest effects of pairing, all used socially mediated reinforcers, including hugs, tickles, rocking, cuddling, blowing bubbles with an adult, hand swinging, and being thrown in the air by four adults using a parachute. More recent studies that have demonstrated fewer pairing effects have all employed edible and tangible reinforcers. It is also interesting to note that socially mediated reinforcers were primarily used with participants who were either typically developing or diagnosed with other developmental disorders, while edible/tangible reinforcers were primarily used with those with autism, perhaps because of the presumption that children in the latter group would not find social interactions reinforcing. However, pairing was less successful with participants with autism than with those in the other two groups, suggesting that this might not be the case. Finally, it is notable that there was no obvious trend between participants' baseline echoic repertoires and the result of pairing. This is especially noteworthy, since much has been made of the importance of children's preintervention vocal repertoires in previous work (Esch et al., 2005; Miguel et al., 2002; Normand & Knoll, 2006).

In light of the information presented in Table 1, the current study was a systematic replication of Miguel et al.'s (2002) work that also sought to extend the research on stimulus-stimulus pairing by (a) employing an alternating treatments design, (b) comparing stimulus pairing against the effects of both a control condition (i.e., an enriched environment) and standard echoic training on the vocal behavior of children with autism and severely delayed language, and (c) establishing a precedent by including more detailed information than in previous studies on the nature of the experimenter-participant relationship and the manner in which the target sounds were presented during pairing.

METHOD

Participants

Jay (age 4), Sara (age 2), and Jane (age 4) participated in the study; all three met the DSM-IV diagnostic criteria for autism. They participated in a publicly funded, home-based, early intensive behavioral intervention program that was based on the curriculum developed by Lovaas (1981) and was provided for up to 35 hrs per week. When the study was initiated, Sara's intervention program was just beginning and Jay and Jane were in their sixth and fourth month of treatment, respectively. All three children were recruited by mail.

The Behavioral Language Assessment (BLA) form (Sundberg & Partington, 1998) was used to assess participants' preintervention verbal repertoires. The BLA is typically conducted via parent interview; scores range from 1–5, with higher scores indicating more advanced vocal communication and language skills.

Jay's BLA was conducted with his father as the informant, and yielded a Level 2–3 profile (27/60). Jay received scores of 5/5 in both the manding and matching sections of the BLA. He was able to mand for at least 10 items via picture exchange and could match most items as well as a 2–4 item block design. He received a score of 1/5 on the echoics section, indicating that he could not repeat any words or sounds. He also received a score of 1/5 on the

tacting section, indicating that he could not label any items or actions vocally.

Sara's mother and father both acted as informants for her BLA, which yielded a Level 2 profile (22/60). Her highest score was 4/5 in the vocal play section, indicating that she vocalized frequently with varied intonation and said a few words (albeit not functionally). She received a score of 2/5 in the manding section, indicating that she pulled people, pointed, or otherwise used gestures (but not words) to mand. Like Jay, she received scores of 1/5 for both echoics and tacting. Baseline observations and parent interviews indicated that she could produce the sounds "ba," "bay," "na," "ma," "ah," "ya," and "da," spontaneously but would not on demand.

Jane's BLA was conducted with her mother and yielded a Level 3 profile (31/60). Jane received scores of 5/5 in both the cooperation and manding sections. She was able to mand for at least 10 items via picture exchange and was able to work well in teaching situations for approximately 10 min. Like Jay and Sara, she received scores of 1/5 for both echoic and tacting. Baseline observations and the parent interview indicated that Jane could produce, but not echo, the sounds "ma," "da," "ba" "up," "puh," "ah," and "mmm." She had acquired the latter three sounds as echoics just prior to the initiation of the study.

Setting and Experimenters

Jay's sessions were conducted in a basement recreation room in his home, which also served as a therapy room during his behavioral intervention sessions. The room was furnished with a couch, television, table, and several chairs. Toys were placed around the room on the floor, and Jay was allowed free access to the toys during research sessions, which occurred once per day, 5 days per week at the same time. Each session lasted approximately 90 min and took place after Jay finished dinner. During the sessions, the experimenter followed Jay around the room and presented pairing trials at designated intervals.

Sara's sessions were conducted at home in her bedroom, which also served as a therapy room during her behavioral intervention sessions. The room was furnished with a locked cabinet, bed, chair, and toy chest with toys. Sara was allowed to play with the toys during research sessions. Sessions were conducted once per day, 5 days per week at approximately the same time each day, for 90 min after Sara finished eating her dinner.

Jane's sessions were conducted at home in her bedroom, which was furnished with a mattress and a variety of toys on the floor. Jane was allowed to play with the toys during the sessions. Sessions were conducted once per day, four days per week at approximately the same time each day. Each session lasted approximately 90 min, and began either before or after Jane's dinner.

None of the experimenters who were involved in the study had previous relationships or reinforcement histories with any of the participants. Their only interactions with the children occurred during experimental conditions. Thus, the experimenters themselves were not conditioned reinforcers for the children.

Target Behaviors and Interobserver Agreement

The target sounds were the three lowest frequency one-syllable sounds for each participant that were produced during baseline and corroborated via parent report. Coincidentally, the sounds were the same for each of the three participants: "ba," "ma," and "da." Sounds were randomly assigned to one of three conditions for each participant.

Measurement and Data Collection

Dependent measures. The primary dependent variables were the total frequency of both target and nontarget sounds produced during 5-min presession and 5-min postsession observations. The observations were conducted immediately before (presession) and after (postsession) each control, standard echoic training, and stimulus-stimulus pairing condition. All observation sessions were videotaped for scoring purposes. At least 25% of treatment sessions were also recorded for each participant, to allow for assessment of procedural reliability.

Inter-rater agreement. Two independent observers scored each videotape during randomly selected sessions for each participant to assess inter-observer agreement for all sounds. Specifically, agreement was calculated for each of the three conditions during

19 of 23 sessions (82.6%) for Jay, 5 of 19 sessions (26.3%) for Sara, and 5 of 17 sessions (29.4%) for Jane. Agreement was calculated by dividing the smaller frequency of sounds recorded during each 5-min interval by the larger frequency. Mean agreement percentages were 92.8% for Jay (range = 75% to 100%), 92.9% for Sara (range = 78% to 100%), and 100% for Jane.

Treatment integrity. Treatment integrity was assessed by a second observer, both in-situ and via videotape, by dividing the number of correctly implemented trials by the total number of trials and multiplying by 100. Treatment integrity was assessed in all three conditions during 6 of 23 sessions (26.1%) for Jay and 5 of 19 sessions (26.3%) for Sara, with a result of 100% for each. Treatment integrity was calculated during 5 of 17 sessions (29.4%) for Jane, with a mean agreement of 99.3% (range = 96.7% to 100%).

Stimulus Preference Assessment

A preference assessment survey (Fisher, Piazza, Bowman, & Amari, 1996) was administered to the parent(s) of each participant at the beginning of the study. On this basis, a list of 4–5 edible items that were presumed to act as reinforcers was generated for each participant. The following edibles were used with Jane: gummy bears, Smarties™, licorice, and fruit candies. The following edibles were used with Jay: chips, granola bars, pepperoni sticks, and small pieces of bacon. The following edibles were used with Sara: pretzels, lollipops, fruit snacks, chips, and juice. All chewable items were sliced into small and quickly consumable pieces. Every day, at the beginning of each condition, one piece of each item was presented in an array to each participant. The piece selected and consumed by the participant was used during all trials that day for that condition (30 trials).

Experimental Design

An alternating treatments design (Barlow & Hersen, 1984) was used to evaluate the effects of stimulus-stimulus pairing, standard echoic training, and a control condition on target sound production. The three experimental conditions were conducted in random order each day with a 10-min break allowed between each condition.

Procedure

Across conditions, the experimenter stood near the participant and moved directly in front of him or her to present trials. Trials were presented every 20 sec for 10 min, for a total of 30 trials per session. A digital timer was used to visually cue the experimenter when to deliver each trial. All target sounds were presented by the experimenter in a monotone fashion with no facial expression, emotional affect, or voice inflection. All edible items used as reinforcers were presented in an equally neutral fashion: the experimenter approached the child, delivered the edible item into the child's hand or directly into his or her mouth, and then immediately backed away.

Baseline. Five-min observations were videotaped immediately before and after each stimulus-stimulus pairing, standard echoic training, and control condition. During these observations, participants were allowed to play with toys; however, there was no or minimal interaction between the experimenter and participants.

Control condition. The control procedure was designed to expose the participant to the same access to edibles as the pairing procedure (thus approximating an enriched environment) without either pairing the target sound with the preferred edible (i.e., automatic reinforcement) or directly reinforcing production of the target sound (i.e., contingent reinforcement). During this condition, the experimenter repeated the target sound 5 times per trial and presented a preferred edible item 10 sec later as described previously, if the participant did not emit a target sound. If a target sound was emitted, the preferred edible item was not presented. This correction procedure was designed to control for adventitious reinforcement of the target sound.

Standard echoic training. During this condition, the experimenter repeated the target sound 5 times per trial and presented a preferred edible item as described previously, upon production of a target sound within 5 sec. If the participant did not emit a target sound, the experimenter did not deliver a preferred edible item and moved away from the participant until the next scheduled interval.

Stimulus-stimulus pairing. During this condition, the experimenter repeated the target sound 5 times per trial and presented a pre-

JAY

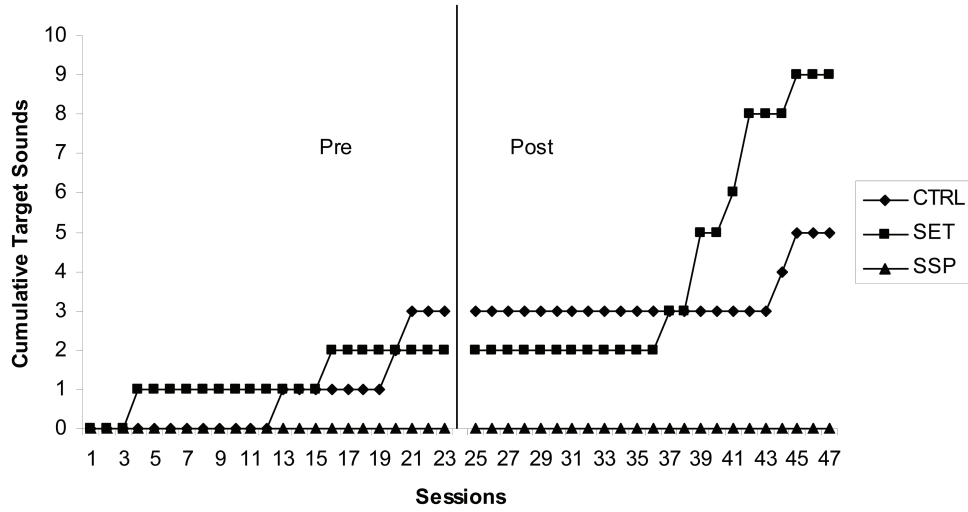

Figure 1. Cumulative target sounds during pre- and postcondition observations for Jay in control (CTRL), standard echoic training (SET) and stimulus-stimulus pairing (SSP) sessions.

ferred edible item as described previously between the second and fifth emission of the target sound. If the participant emitted a target sound at any point, the edible item was not delivered in order to control for direct reinforcement (echoic contingency).

RESULTS

Results for each participant are presented in the sections that follow.

Jay

Figure 1 displays the frequency of target sounds for Jay in each of the three conditions.

There was no substantive increase in Jay's target sounds following exposure to any of the three experimental conditions. Whereas the target sound assigned to standard echoic training ("ba") was produced most frequently, it was not under echoic control after 700 trials and was produced a total of only seven times during 23 poststandard echoic training observations. The target sound assigned to the stimulus-stimulus pairing condition ("da") was not observed during any of the pre- or postpairing observations. Nontarget vocalizations (i.e., free operant "vocal play") also failed to increase as a result of exposure to any of the three experimental conditions.

Jane

Figure 2 displays the results for Jane.

As was the case for Jay, neither the frequency of Jane's target or nontarget sounds increased following exposure to any of the three experimental conditions. Although the target sound associated with the stimulus-stimulus pairing condition ("ba") was produced twice during the first 4 sessions, it is unlikely that this small, short-lived increase occurred as a result of pairing.

Sara

The results for Sara are displayed in Figure 3.

The frequency of Sara's target sound production did not increase following exposure to either the control condition or standard echoic training. However, there was an immediate but short-lived effect of pairing during the first 5 sessions (sessions 21–25 in Figure 3), during which target sound production ("da") increased. Also, prepairing production of the target sound increased during the final

JANE

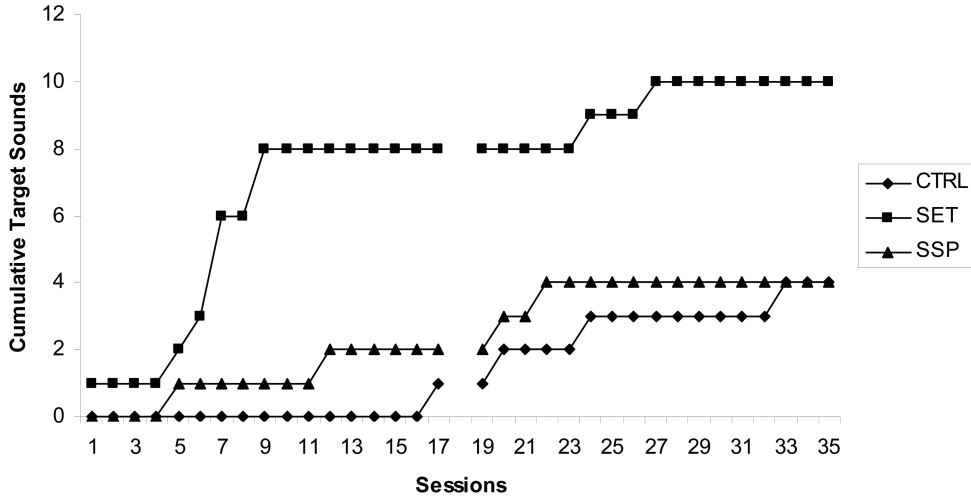

Figure 2. Cumulative target sounds during pre- and postcondition observations for Jane in control (CTRL), standard echoic training (SET) and stimulus-stimulus pairing (SSP) sessions.

SARA

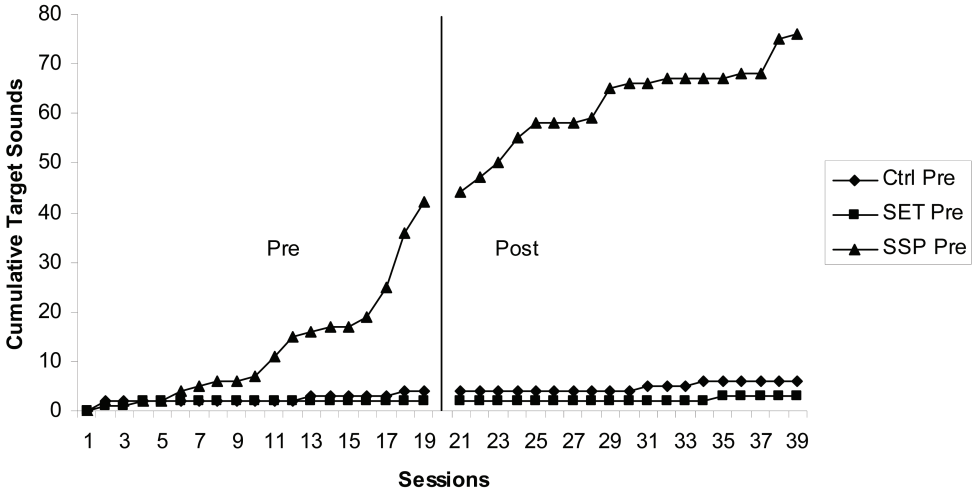

Figure 3. Cumulative target sounds during pre- and postcondition observations for Sara in control (CTRL), standard echoic training (SET) and stimulus-stimulus pairing (SSP) sessions.

experimental sessions (sessions 16–19) and this did not occur in other conditions. Nontarget vocalizations did not increase as a result of exposure to any of the three experimental conditions.

DISCUSSION

The results of the current study are consistent with those of other studies published over the past 6 years indicating that stimulus-stimu-

lus pairing appears to be largely ineffective with some children in increasing postpairing target vocalizations. However, these results need to be interpreted with caution. For example, a short-lived effect was noted for Sara and the motivating operations need to be critically analyzed (below). Sara's prepairing production of the target sound also increased during the final sessions of the study and this may be attributed to the preceding history of stimulus pairing for that sound. This study also demonstrated that stimulus-stimulus pairing was no more effective than either an enriched environment (i.e., control condition) or standard echoic training. However, an unanticipated result, albeit supported only anecdotally, was the increased frequency of "happiness indicators" such as smiling and laughing (Green & Reid, 1999, p. 284) during both the stimulus-stimulus pairing and control conditions compared to the standard echoic training condition. During the first two conditions, both of which were characterized by ready access to edibles and low demand, the children approached the experimenter quite often while smiling and opening their mouths in anticipation of receiving edible items. In contrast, they quickly learned to discriminate the sound correlated with the standard echoic condition, in which an imitative response was required in order for them to gain access to reinforcers; and their social behavior changed dramatically during this time. For instance, Jay often whined and ran away from the experimenter when presented with the sound that signaled the echoic condition. It appeared that standard echoic training acted as a conditioned aversive stimulus, either because of the children's reinforcement history during previously unsuccessful echoic training or because, in this experiment, this was the only condition in which a demand was inherent.

The main question that emerges from these findings is, "Why does this procedure appear to be ineffective, despite its theoretical appeal?" Given that the earliest studies in this area produced significant effects whereas the more recent studies have not, the answer may lie in the differences between these two bodies of research and all the variations.

Participants

In the earliest studies, in which pairing effects were more apparent (Smith et al., 1996; Sundberg et al., 1996; Yoon & Bennett, 2000), participants ranged from those who were typically developing to those labeled with mental retardation, developmental delays, or autism. In particular, only 20% of participants in these early studies had a diagnosis of autism. This is in contrast to more recent research (Miguel et al., 2002; Esch et al., 2005; Normand & Knoll, 2006) in which the participants have been exclusively children with autism. If the present study is included, a total of 10 participants with autism have been involved in this recent body of work. Of these, 70% failed to show any effect of pairing and only 30% showed effects of any magnitude. Thus, one could suggest that stimulus-stimulus pairing is less effective for children with autism than for children with other developmental profiles. However, it is important to examine factors in addition to those that are child-related before accepting that suggestion.

Procedural Variables

Rate and density of pairings. Another difference between early and more recent studies is that the former tended to employ a higher rate of pairings per minute with fewer sounds per trial than the more recent studies. On average, the early studies employed a mean of 9.57 pairing trials per session with one sound per trial, while the later studies employed a mean of 4.95 trials per session (or less) with 4–5 sounds per trial. This suggests that more pairing trials with fewer repetitions per trial result in better outcomes. In the current study the target sound was presented 5 times per trial for 30 trials per session. This means that each participant had the target sound presented to them 150 times per session but only received 30 edible items. One interpretation of this is that the target sound was paired more frequently with the temporary withholding of reinforcement and less frequently with the immediate presentation of the edible. Therefore, it seems preferable to present only one sound per trial so that reinforcement follows every presentation of the sound. Finally, it is also important to consider that typical pairing occurs thousands of times per day on a continuous basis. In the literature, pairing trials only occur in small amounts (i.e., 30 per day). Future research may wish to explore the effect of larger numbers of trials per day.

Reinforcer type. In addition, all of the early studies employed social reinforcers rather

than edible/tangible reinforcers. There may be several reasons for the recent change in this regard. Edible items lend themselves to stimulus preference assessments more readily than social activities, and may require less effort to deliver as well. Additionally, recent researchers (Esch et al., 2005; Miguel et al., 2002; Normand & Knoll, 2006) may have assumed that unconditioned reinforcers would be more effective than conditioned reinforcers for children with autism, given their impaired social interaction skills. Regardless, it is clear from Table 1 that social reinforcers were associated more often with a positive pairing effect than were edible/tangible reinforcers, even in children with autism. This suggests that future research with children with autism should explore the impact of social reinforcers within a stimulus-stimulus pairing paradigm. In order to accomplish this, future researchers should heed the advice of recent authors concerning the need for reinforcer assessments (Miguel et al., 2002; Normand & Knoll, 2006).

Another, but critical, consideration regarding the use of edible reinforcers involves the concept of motivating operations (MO; Michael, 2007). The current study did not control for access to edibles prior to each experimental session. Therefore, it is possible that the children simply were not hungry when exposed to the experimental conditions (i.e., the MO for edibles was weak or absent). As indicated above, experimental sessions reliably followed dinner for both Sara and Jay and occasionally for Jane. It is possible that Sara had a stronger MO for food during sessions than either Jay or Jane. It is also possible that the relative value of the edibles available to Sara was higher than for those available to Jay or Jane. For example, Sara's access to the edibles may have been restricted to the experimental sessions while Jay or Jane had access to theirs outside of sessions. The results for any of the three participants may have been different if sessions were conducted at other times of day. And finally, it is important to note that five preferred items were identified for each participant at the outset of the study and presented at the beginning of each condition (3 times per session). So, while there was choice provided every 30 trials, the same 4–5 items were presented nearly 60 times to each participant across the span of the study. Even if a MO for food was in effect, the items available may have lost some of their value after so many presentations. Future researchers should consider the MO for edibles and document efforts to control for this variable.

Experimenter familiarity. Another factor to consider is who presented the target sounds. The authors of two of the three successful pairing studies indicated that the experimenter was familiar or related to the participants (Smith et al., 1996; Sundberg et al., 1996). In the present study, the experimenter was unknown to the participants; no other studies have specified this relationship. Perhaps, a familiar individual acts as a conditioned reinforcer and thus enhances the effectiveness of the putative reinforcer, regardless of whether it is social or edible/tangible. Future authors should include information in this regard, since it may have a direct bearing on how the stimulus-stimulus pairing procedure is implemented most effectively.

Manner of target sound presentation. The manner in which the sounds are presented during pairing trials also deserves consideration. Consider the interactions that typically occur during early vocal play activities between adults and typically-developing infants (with whom an operant analysis has been demonstrated; see Moerk, 1990). The adult usually models target sounds repeatedly in a singsong or animated voice, often accompanied by smiles, eye-to-face gaze, and other affectively positive facial expressions directed at the infant. However, it is interesting to note that almost no mention has been made of the manner of sound delivery in past research with participants with impaired language, with one exception. Sundberg et el. (1996) indicated that "several different pitches and intonations were used with each sound, word, or phrase" (p. 25); perhaps as a result of this animated style of target sound presentation, all 5 participants in this study, including 2 with autism, showed a positive pairing effect (although not with all words). This is in contrast to the results of the present study, in which target sounds were presented in a monotone fashion with no facial expression, emotional affect, or voice inflection; reinforcers were delivered in a similarly neutral manner. In order to determine the importance of this issue, future researchers should include descriptions of the manner in which target sounds are presented. In addition, studies that compare the manner of target

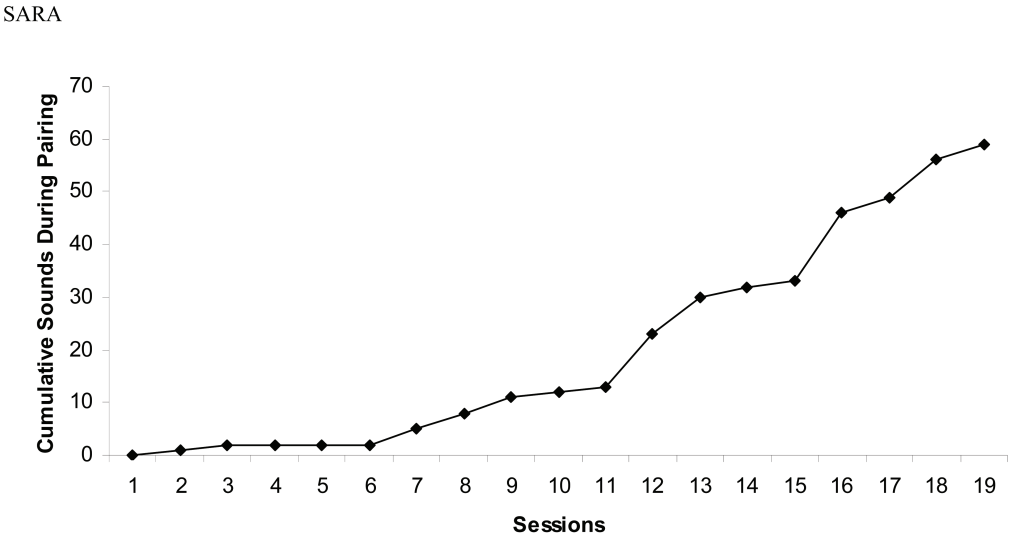

Figure 4. Cumulative target sound production during stimulus-stimulus pairing for Sara.

sound delivery as an independent variable (e.g., neutral vs. animated affect; monotone vs. sing-song voice) would help to clarify this issue.

Reinforcement variables. Another way in which stimulus-stimulus pairing research with language impaired participants appears to differ from the natural vocal play interactions that occur between adults and infants is with regard to reinforcement delivery. Typically, adults pair reinforcers (e.g., pleasurable touches, smiles, etc.) with vocalizations on a continuous basis during eating, changing, and other routines, with little or no differentiation between "trials." However, in much of the recent research with language impaired children, 3–7 sounds were presented by the adult prior to providing an opportunity (pause) for the child to echo (although the child could technically echo at anytime). These may have functioned as extinction trials. In addition there was no social interaction occurring between trials. In the end, this means that the interactions between adults and participants were probably less fluid and less socially interactive than occurs with typically-developing infants. This may add to the ineffectiveness of the procedure with children with autism who may require more direct reinforcement during initial pairing trials, because of the nature of their learning difficulties.

In this regard, Carbone (2004) has suggested that immediate and direct reinforcement be available in the event that the target sound is produced during pairing sessions. The data for Sara provides some support for this suggestion.

Her initial increase in postpairing vocalizations of the target sound (Figure 3) was followed by both a decrease in postpairing production and a concurrent increase in production *during* pairing trials, as measured by the number of trials omitted due to target sound production. Had direct and immediate reinforcement been available to her during the trials themselves, her rate of production might have maintained at an increased level or continued to increase. Future research could explore this issue by employing a reinforcement schedule that more closely approximates the conditions under which pairing naturally occurs.

Summary

The results of this study replicated recent research that has failed to reliably demonstrate the effectiveness of stimulus-stimulus pairing in children with autism. Of the 3 participants in this study, temporary effects were only seen for 1 participant. However, these results were obtained in spite of the fact that sessions were conducted at a time of day that brings the MO for food into question (right after dinner) and trials were presented in an emotionally flat and

monotone fashion by unknown experimenters. Therefore, before we conclude that this procedure, for whatever reason, is not clinically useful for increasing vocal sound production in this population we must consider all of the independent variables discussed here. We have suggested that numerous procedural variables may contribute to this lack of reliable effect. We have also provided suggestions for future research aimed at examining the relevance of these issues. We believe that such an examination is warranted, given the potential of this procedure for solving a problem (i.e., lack of vocal sound production) that is of considerable clinical importance for children with autism and those who support them.

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